

## *Stereo Input available to Single-Ended/differential Mode* *Low voltage, Volume Controller With Soft Step.* *Gain/Loss, Low power consumption.*

### FEATURES

- Operation range: 2.5V~6.5V.
- One quasi-differential input.
- Soft step volume control : -79dB ~ +15dB.
- Input Gain: 0dB ~ +15dB.
- Low power consumption.
- Good PSRR and low pop noise.
- I<sup>2</sup>C interface.
- Housed in 10 pin MSOP package.

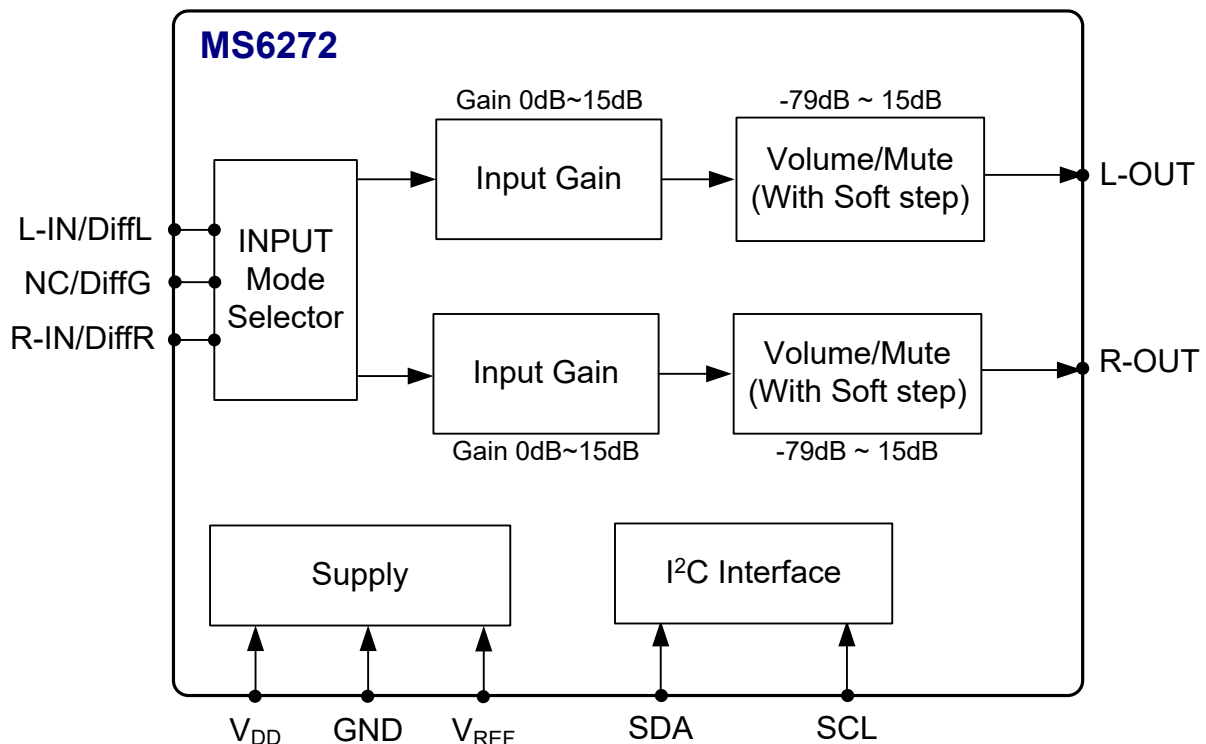
### APPLICATIONS

- Multimedia system
- Hi-Fi audio system.
- Bluetooth.
- DAB

### DESCRIPTION

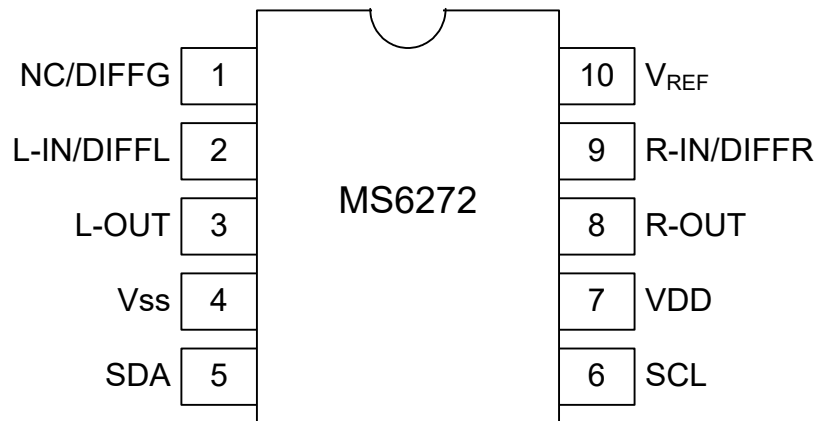
The MS6272 is a audio volume controller IC with stereo input( Single-ended/differential).  
It has input gain(0 ~ +15dB), Soft step volume control(-79dB ~ +15dB) with programmable blend times.  
It uses CMOS technology specially for the low voltage application with low noise, rail-to-rail output.

### BLOCK DIAGRAM



## PIN CONFIGURATION

| Symbol           | Pin | Description                                           |
|------------------|-----|-------------------------------------------------------|
| NC/DIFFG         | 1   | No Connected /Differential Stereo Input Common        |
| L-IN/DIFFL       | 2   | Left Channel Input / Left Differential Stereo Input   |
| L-OUT            | 3   | Left Channel Output                                   |
| V <sub>SS</sub>  | 4   | Ground                                                |
| SDA              | 5   | I <sup>2</sup> C Data Input                           |
| SCL              | 6   | I <sup>2</sup> C Clock Input                          |
| V <sub>DD</sub>  | 7   | Positive Supply Voltage                               |
| R-OUT            | 8   | Right Channel Output                                  |
| R-IN/DIFFR       | 9   | Right Channel Input / Right Differential Stereo Input |
| V <sub>REF</sub> | 10  | Reference Voltage = 1/2V <sub>DD</sub>                |



## ORDERING INFORMATION

| Package                 | Part number | Packaging Marking | Transport Media          |
|-------------------------|-------------|-------------------|--------------------------|
| 10-Pin MSOP (lead free) | MS6272MGTR  | 6272G             | 3.5k Units Tape and Reel |
| 10-Pin MSOP (lead free) | MS6272MGU   | 6272G             | 80 Units Tube            |

RoHS Compliance

## ABSOLUTE MAXIMUM RATINGS

| Symbol            | Parameter                                                         | Rating        | Unit |
|-------------------|-------------------------------------------------------------------|---------------|------|
| V <sub>DD</sub>   | Supply Voltage                                                    | 6.5           | V    |
| V <sub>ESD</sub>  | Electrostatic Handling                                            | -3000 to 3000 | V    |
| T <sub>STG</sub>  | Storage Temperature Range                                         | -65 to 150    | °C   |
| T <sub>A</sub>    | Operating Ambient Temperature Range                               | -40 to 85     | °C   |
| T <sub>J</sub>    | Maximum Junction Temperature                                      | 120           | °C   |
| T <sub>S</sub>    | Soldering Temperature, 10 seconds                                 | 260           | °C   |
| R <sub>THJA</sub> | Thermal Resistance from Junction to Ambient in Free Air<br>MSOP10 | 165.9         | °C/W |

## OPERATING RATINGS

| Symbol          | Parameter      | Min | Typ | Max | Unit |
|-----------------|----------------|-----|-----|-----|------|
| V <sub>DD</sub> | Supply Voltage | 2.5 | -   | 6.5 | V    |

## 5V ELECTRICAL CHARACTERISTICS

(T<sub>a</sub>=25°C, All stages 0dB, f=1kHz, C<sub>REF</sub>=1uF, refer to the application circuit; unless otherwise specified)

| Symbol               | Parameter                            | Conditions                        | Min  | Typ    | Max | Unit |
|----------------------|--------------------------------------|-----------------------------------|------|--------|-----|------|
| Supply               |                                      |                                   |      |        |     |      |
| I <sub>Q</sub>       | Quiescent Current                    | V <sub>IN</sub> =0V               | -    | 4.2    | -   | mA   |
| I <sub>PD</sub>      | Power down current                   | V <sub>IN</sub> =0V               | -    | 120    | -   | uA   |
| PSRR                 | Power Supply Rejection Ratio         | C <sub>REF</sub> = 1uF, f = 100Hz | 55   | 58     | -   | dB   |
| Input Selectors      |                                      |                                   |      |        |     |      |
| R <sub>IN</sub>      | Input Resistance                     | Single-Ended                      |      | 100    |     | kΩ   |
| R <sub>IN-Diff</sub> | Input Resistance                     | Differential                      |      | 100    |     | kΩ   |
| G <sub>IN</sub>      | Input Gain Range                     | Gain                              | 0    | -      | 15  | dB   |
| G <sub>STEP</sub>    | Step Resolution                      |                                   | -    | 1      | -   | dB   |
| ERR <sub>G</sub>     | Gain Setting error                   |                                   | -0.2 | 0      | 0.2 | dB   |
| CMRR                 | Common mode rejection ratio          | VCM = 1Vrms @ 1KHz                | 40   | 55     | -   | dB   |
|                      |                                      | VCM = 1Vrms @ 10KHz               | 40   | 55     | -   | dB   |
| Volume control       |                                      |                                   |      |        |     |      |
| CR <sub>VOL</sub>    | Volume Control Range                 | Attenuation & Gain                | -79  | -      | +15 | dB   |
| RES <sub>VOL</sub>   | Volume Step Resolution               |                                   | -    | 1      | -   | dB   |
| ERR <sub>VOL</sub>   | Volume Setting Error                 | Av = +15 to -40dB                 | -0.5 | 0      | 1   | dB   |
|                      |                                      | Av = -40 to -79dB                 | -1   | 0      | 5   | dB   |
| MUTE                 | Mute Attenuation                     | Vin=0dBV                          |      | -90    |     | dB   |
| General              |                                      |                                   |      |        |     |      |
| VO <sub>MAX</sub>    | Maximum Output Voltage Swing         | (THD+N)/S <0.1%                   | -    | 1.59   | -   | Vrms |
| THD+N                | Total Harmonic Distortion Plus Noise | V <sub>OUT</sub> = 1Vrms          | -    | -75    | -   | dB   |
|                      |                                      |                                   | -    | 0.0177 | -   | %    |
| S/N                  | Signal-to-Noise Ratio                | V <sub>OUT</sub> = 1Vrms          | -    | 93     | -   | dB   |
| Bus Input            |                                      |                                   |      |        |     |      |
| V <sub>IH</sub>      | Bus High Input Level                 |                                   | 1.8  | -      | -   | V    |
| V <sub>IL</sub>      | Bus Low Input Level                  |                                   | -    | -      | 0.8 | V    |

### 3.3V ELECTRICAL CHARACTERISTICS

(Ta=25°C, All stages 0dB, f=1kHz, C<sub>REF</sub>=1uF, refer to the application circuit; unless otherwise specified)

| Symbol            | Parameter                            | Conditions                        | Min | Typ  | Max | Unit |
|-------------------|--------------------------------------|-----------------------------------|-----|------|-----|------|
| <b>Supply</b>     |                                      |                                   |     |      |     |      |
| I <sub>Q</sub>    | Quiescent Current                    | V <sub>IN</sub> =0V               | -   | 3.6  | -   | mA   |
| I <sub>PD</sub>   | Power down current                   | V <sub>IN</sub> =0V               | -   | 80   | -   | uA   |
| PSRR              | Power Supply Rejection Ratio         | C <sub>REF</sub> = 1uF, f = 100Hz | 65  | 70   | -   | dB   |
| <b>General</b>    |                                      |                                   |     |      |     |      |
| VO <sub>MAX</sub> | Maximum Output Voltage Swing         | (THD+N)/S <0.1%                   | -   | 1    | -   | Vrms |
| THD+N             | Total Harmonic Distortion Plus Noise | V <sub>OUT</sub> = 0.707Vrms      | -   | -70  | -   | dB   |
|                   |                                      |                                   | -   | 0.03 | -   | %    |
| S/N               | Signal-to-Noise Ratio                | V <sub>OUT</sub> = 0.707Vrms      | -   | 90   | -   | dB   |

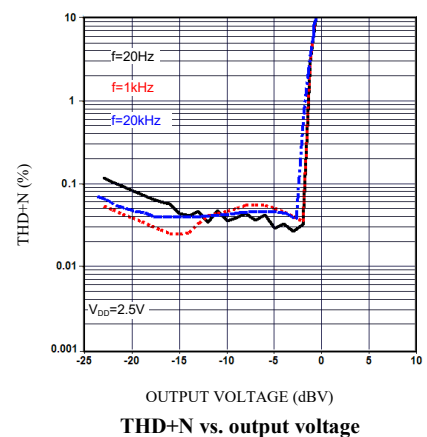
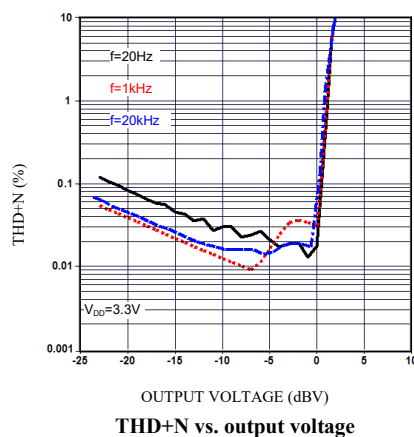
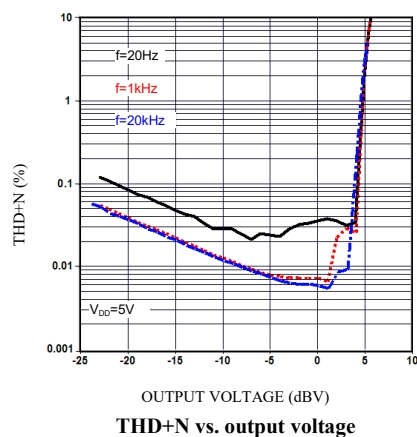
### 2.5V ELECTRICAL CHARACTERISTICS

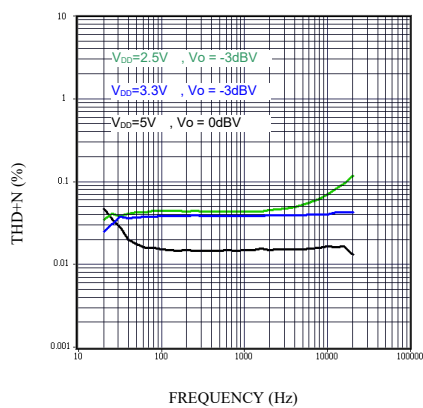
(Ta=25°C, All stages 0dB, f=1kHz, C<sub>REF</sub>=1uF, refer to the application circuit; unless otherwise specified)

| Symbol            | Parameter                            | Conditions                        | Min | Typ  | Max | Unit |
|-------------------|--------------------------------------|-----------------------------------|-----|------|-----|------|
| <b>Supply</b>     |                                      |                                   |     |      |     |      |
| I <sub>Q</sub>    | Quiescent Current                    | V <sub>IN</sub> =0V               | -   | 3.3  | -   | mA   |
| I <sub>PD</sub>   | Power down current                   | V <sub>IN</sub> =0V               | -   | 60   | -   | uA   |
| PSRR              | Power Supply Rejection Ratio         | C <sub>REF</sub> = 1uF, f = 100Hz | 60  | 65   | -   | dB   |
| <b>General</b>    |                                      |                                   |     |      |     |      |
| VO <sub>MAX</sub> | Maximum Output Voltage Swing         | (THD+N)/S <0.1%                   | -   | 0.8  | -   | Vrms |
| THD+N             | Total Harmonic Distortion Plus Noise | V <sub>OUT</sub> = 0.707Vrms      | -   | -67  | -   | dB   |
|                   |                                      |                                   | -   | 0.04 | -   | %    |
| S/N               | Signal-to-Noise Ratio                | V <sub>OUT</sub> = 0.707Vrms      | -   | 90   | -   | dB   |

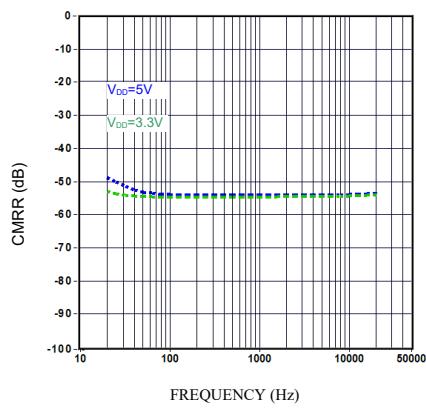
### TYPICAL PERFORMANCE CHARACTERISTICS

(Ta=25°C, R<sub>L</sub>=10kΩ, C<sub>REF</sub>=1uF; unless otherwise specified)

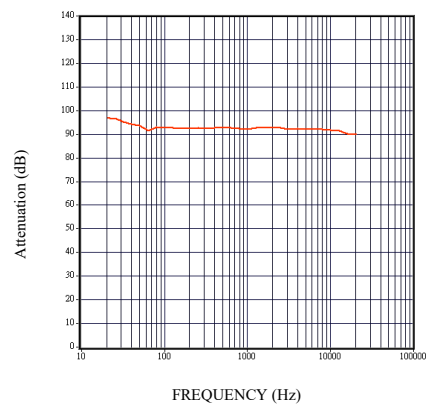




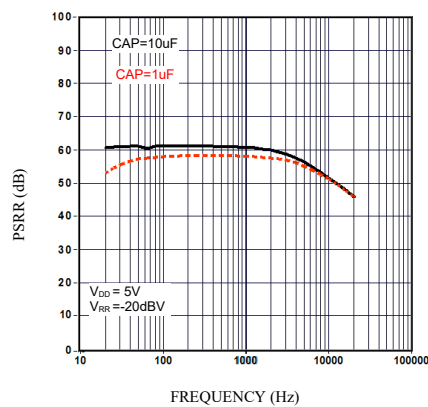
THD+N vs. frequency



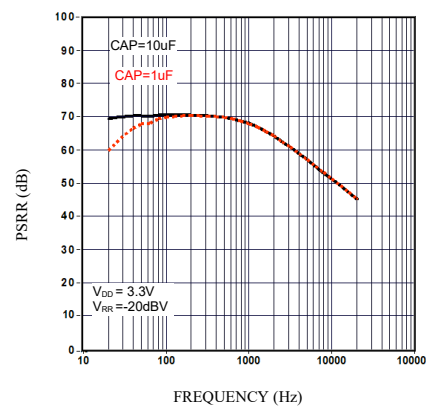
CMRR vs. frequency



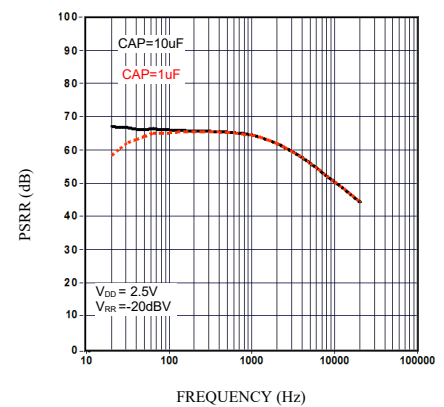
Mute vs. frequency



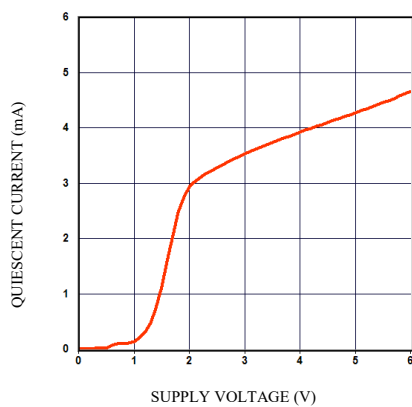
PSRR vs. frequency



PSRR vs. frequency



PSRR vs. frequency

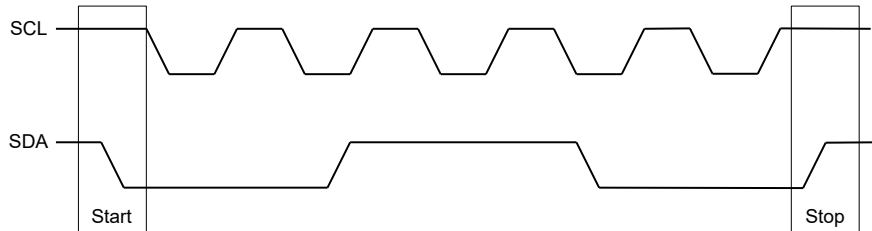


Quiescent current vs. supply voltage

## I<sup>2</sup>C BUS DESCRIPTION

### Start and stop conditions

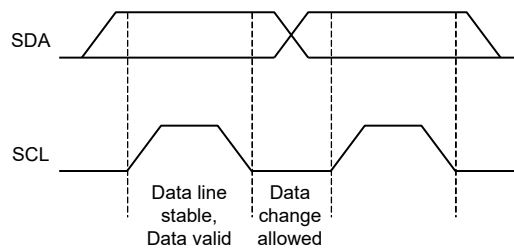
A start condition is activated when the SCL is set to HIGH and SDA shifts from HIGH to LOW state. The stop condition is activated when SCL is set to HIGH and SDA shifts from LOW to HIGH state. Please refer to the timing diagram below.



SCL : Serial Clock Line, SDA : Serial Data Line

### Data validity

A data on the SDA line is considered valid and stable only when the SCL signal is in HIGH state. The HIGH and LOW states of the SDA line can only change when the SCL signal is LOW. Please refer to the figure below.

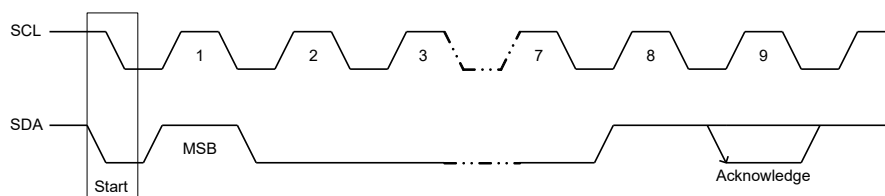


### Byte format

Every byte transmitted to the SDA line consists of 8 bits. Each byte must be followed by an acknowledge bit. The MSB is transmitted first.

### Acknowledge

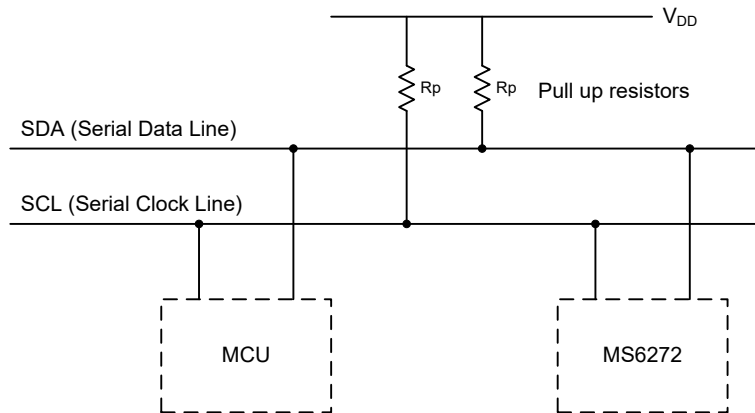
During the Acknowledge clock pulse, the master (up) put a resistive HIGH level on the SDA line. The peripheral (audio processor) that acknowledges has to pull-down (LOW) the SDA line during the Acknowledge clock pulse so that the SDA line is in a stable LOW state during this clock pulse. Please refer to the diagram below.



The audio processor that has been addressed has to generate an Acknowledge after receiving each byte, otherwise, the SDA line will remain at the HIGH level during the ninth (9<sup>th</sup>) clock pulse. In this case, the master transmitter can generate the STOP information in order to abort the transfer.

## BUS INTERFACE

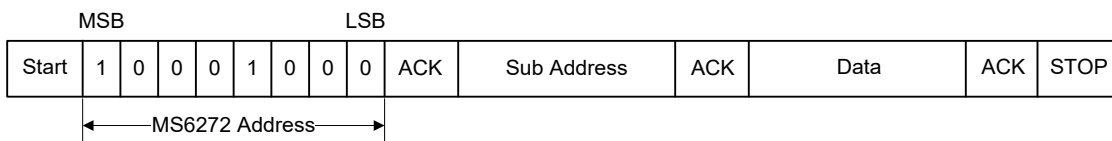
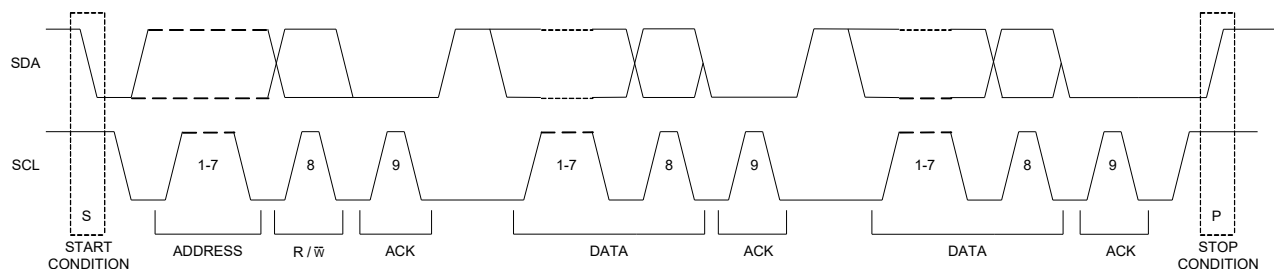
Data are transmitted to and from the MCU to the MS6272 via the SDA and SCL. The SDA and SCL make up the BUS interface. It should be noted that pull-up resistors must be connected to the positive supply voltage.



### Interface protocol

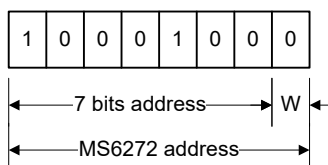
The format consists of the following

- A START condition
- A chip address byte including the MS6272 address. (7bits)
- The 8<sup>th</sup> bit of the byte must be "0".
- The MS6272 must always acknowledge the end of each transmitted byte.
- A data sequence (N-bytes + Acknowledge)
- A STOP condition



### Chip Address

The chip address of the MS6272 is 88H.



## SubAddress

| MSB |    |    |    |    |    |    | LSB | Function                                   |
|-----|----|----|----|----|----|----|-----|--------------------------------------------|
| A7  | A6 | A5 | A4 | A3 | A2 | A1 | A0  |                                            |
| 0   | 0  | 0  | 0  | 0  | 0  | 0  | 0   | Soft-step time / ON/OFF , SE/DIFF Selector |
| 0   | 0  | 0  | 0  | 0  | 0  | 0  | 1   | L-channel Input Gain Control               |
| 0   | 0  | 0  | 0  | 0  | 0  | 1  | 0   | R-channel Input Gain Control               |
| 0   | 0  | 0  | 0  | 0  | 0  | 1  | 1   | Both channels Input Gain Control           |
| 0   | 0  | 0  | 0  | 0  | 1  | 0  | 0   | L-channel Volume Control                   |
| 0   | 0  | 0  | 0  | 0  | 1  | 0  | 1   | R-channel Volume Control                   |
| 0   | 0  | 0  | 0  | 0  | 1  | 1  | 0   | Both channels Volume Control               |
| 0   | 0  | 0  | 0  | 0  | 1  | 1  | 1   | Power management                           |

## Soft-step time / ON / OFF , SE/DIFF Selector (0H)

| MSB |    |    |    |    |    |    | LSB | Function       |
|-----|----|----|----|----|----|----|-----|----------------|
| D7  | D6 | D5 | D4 | D3 | D2 | D1 | D0  |                |
|     |    |    |    |    | 0  | 0  | 0   | Soft-step Time |
|     |    |    |    |    | 0  | 0  | 1   | 0.64ms         |
|     |    |    |    |    | 0  | 1  | 0   | 1.28ms         |
|     |    |    |    |    | 0  | 1  | 1   | 2.56ms         |
|     |    |    |    |    | 1  | 0  | 0   | 5.12ms         |
|     |    |    |    |    | 1  | 0  | 1   | 10.24ms        |
|     |    |    |    |    | 1  | 1  | 0   | 20.48ms        |
|     |    |    |    |    | 1  | 1  | 1   | 40.96ms        |
|     |    |    |    | 0  |    |    |     | 81.92ms        |
|     |    |    |    | 1  |    |    |     | Soft-step On   |
| 0   |    |    |    |    |    |    |     | Off            |
|     |    |    |    |    |    |    |     | SE/DIFF        |
| 1   |    |    |    |    |    |    |     | Differential   |
|     |    |    |    |    |    |    |     | Single-ended   |

The initial condition is Single-ended, Soft-step Off, Soft-step time 40.96ms.

## Input Gain Control (01H , 02H , 03H)

| MSB |    |    |    |    |    |    | LSB | Function |
|-----|----|----|----|----|----|----|-----|----------|
| D7  | D6 | D5 | D4 | D3 | D2 | D1 | D0  | Gain     |
|     |    | 1  | 1  | 0  | 0  | 0  | 0   | 0dB      |
|     |    | 1  | 1  | 0  | 0  | 0  | 1   | 1dB      |
|     |    | 1  | 1  | 0  | 0  | 1  | 0   | 2dB      |
|     |    | 1  | 1  | 0  | 0  | 1  | 1   | 3dB      |
|     |    | 1  | 1  | 0  | 1  | 0  | 0   | 4dB      |
|     |    | 1  | 1  | 0  | 1  | 0  | 1   | 5dB      |
|     |    | 1  | 1  | 0  | 1  | 1  | 0   | 6dB      |
|     |    | 1  | 1  | 0  | 1  | 1  | 1   | 7dB      |
|     |    | 1  | 1  | 1  | 0  | 0  | 0   | 8dB      |
|     |    | 1  | 1  | 1  | 0  | 0  | 1   | 9dB      |
|     |    | 1  | 1  | 1  | 0  | 1  | 0   | 10dB     |
|     |    | 1  | 1  | 1  | 0  | 1  | 1   | 11dB     |
|     |    | 1  | 1  | 1  | 1  | 0  | 0   | 12dB     |
|     |    | 1  | 1  | 1  | 1  | 0  | 1   | 13dB     |
|     |    | 1  | 1  | 1  | 1  | 1  | 0   | 14dB     |
|     |    | 1  | 1  | 1  | 1  | 1  | 1   | 15dB     |

The initial condition 14dB. We suggest the gain is set as the power is up. For example, set and fix the gain +10dB, the volume range will be controlled from -69dB to +25dB.

## Volume Control (04H , 05H , 06H)

| MSB |    |    |    |    |    |    | LSB | Function |
|-----|----|----|----|----|----|----|-----|----------|
| D7  | D6 | D5 | D4 | D3 | D2 | D1 | D0  | Volume   |
|     | 0  | 0  | 0  | 1  | 1  | 1  | 1   | +15dB    |
|     | 0  | 0  | 0  | 1  | 1  | 1  | 0   | +14dB    |
|     | :  | :  | :  | :  | :  | :  | :   | :        |
|     | 0  | 0  | 0  | 0  | 0  | 0  | 0   | 0dB      |
|     | 0  | 0  | 1  | 0  | 0  | 0  | 0   | 0dB      |
|     | 0  | 0  | 1  | 0  | 0  | 0  | 1   | − 1dB    |
|     | :  | :  | :  | :  | :  | :  | :   | :        |
|     | 0  | 0  | 1  | 1  | 1  | 1  | 1   | −15dB    |
|     | 0  | 1  | 0  | 0  | 0  | 0  | 0   | −16dB    |
|     | :  | :  | :  | :  | :  | :  | :   | :        |
|     | 0  | 1  | 0  | 1  | 1  | 1  | 1   | −31dB    |
|     | 0  | 1  | 1  | 0  | 0  | 0  | 0   | −32dB    |
|     | :  | :  | :  | :  | :  | :  | :   | :        |
|     | 0  | 1  | 1  | 1  | 1  | 1  | 1   | −47dB    |
|     | 1  | 0  | 0  | 0  | 0  | 0  | 0   | −48dB    |
|     | :  | :  | :  | :  | :  | :  | :   | :        |
|     | 1  | 0  | 0  | 1  | 1  | 1  | 1   | −63dB    |
|     | 1  | 0  | 1  | 0  | 0  | 0  | 0   | −64dB    |
|     | :  | :  | :  | :  | :  | :  | :   | :        |
|     | 1  | 0  | 1  | 1  | 1  | 1  | 1   | −79dB    |
|     | 1  | 1  | X  | X  | X  | X  | X   | Mute     |

The initial condition is Mute.

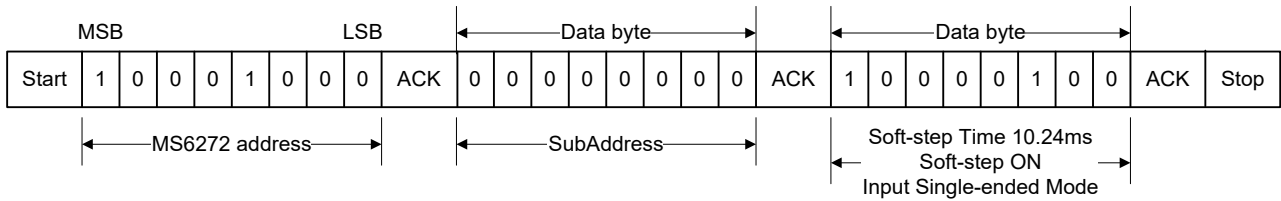
## Power management (07H)

| MSB |    |    |    |    |    |    | LSB | Function                                    |
|-----|----|----|----|----|----|----|-----|---------------------------------------------|
| D7  | D6 | D5 | D4 | D3 | D2 | D1 | D0  |                                             |
|     |    |    |    |    |    |    | 0   | Release of $V_{REF}$ to GND.                |
|     |    |    |    |    |    |    | 1   | Set the voltage of $V_{REF}$ to $1/2V_{DD}$ |
|     |    |    |    |    | 0  | X  |     | All devices Active                          |
|     |    |    |    |    | 1  | 1  |     | Power down                                  |

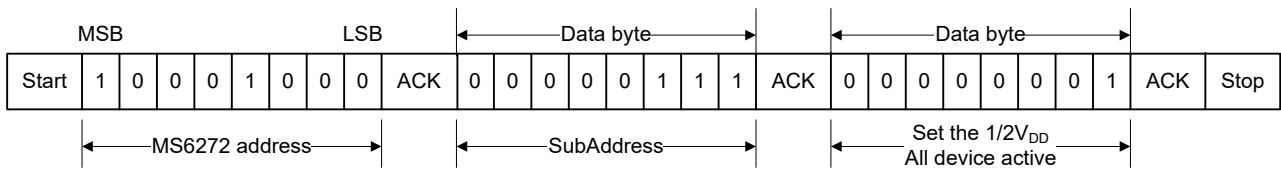
The initial condition is Power down ,  $V_{REF} = GND$ .

## Example

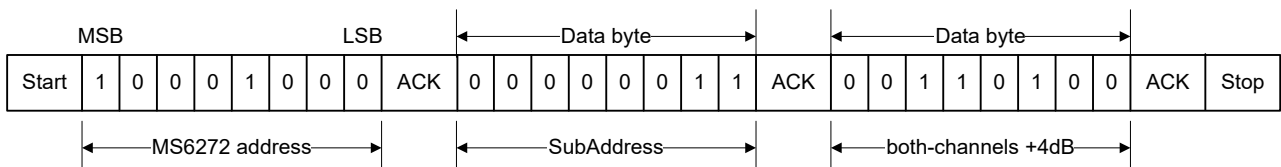
Soft-step Time 10.24ms , Soft-step ON , Single-ended Mode.



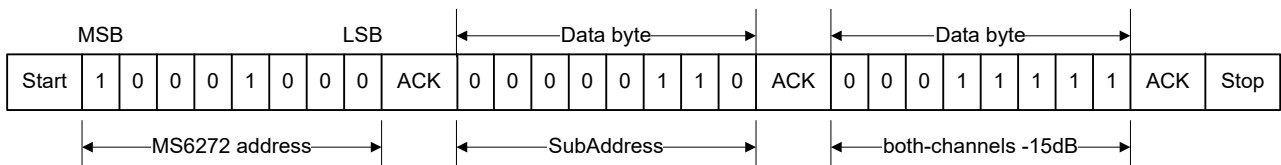
Set the  $1/2V_{DD}$  , All device active.



Set Input gain of both channels at +4dB.



Set Volume of both-channels at -15dB



## Soft-step volume

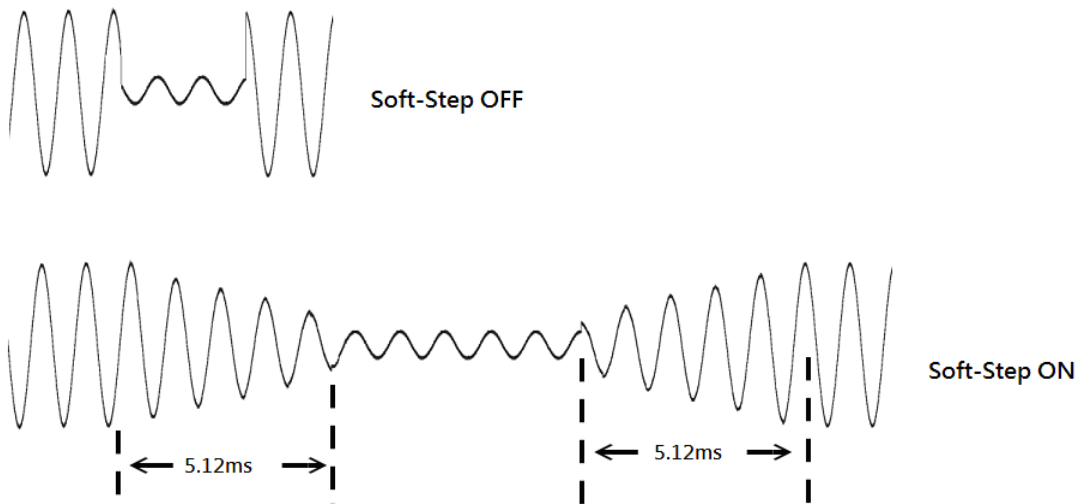
When the volume-level is changed audible clicks could appear at the output. The root cause of those clicks could be the sudden change of the envelope of the audio signal. With the Soft-step feature, this click could be reduced to a minimum. Soft-step supports N dB volume change, including mute.

### Example

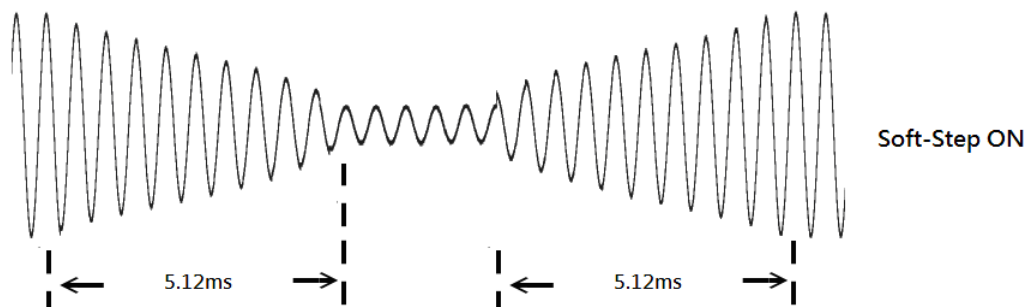
**Soft-Step Time = 5.12ms**

**0dB → -16dB → 0dB**

$V_{in} = 1V_{rms} @ 1KHz$

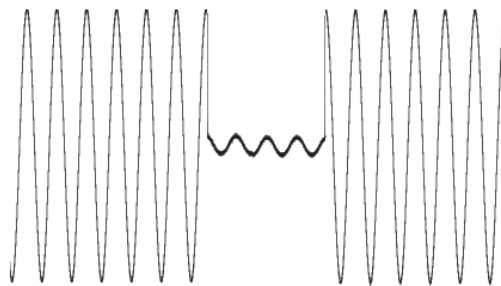


$V_{in} = 1V_{rms} @ 2KHz$

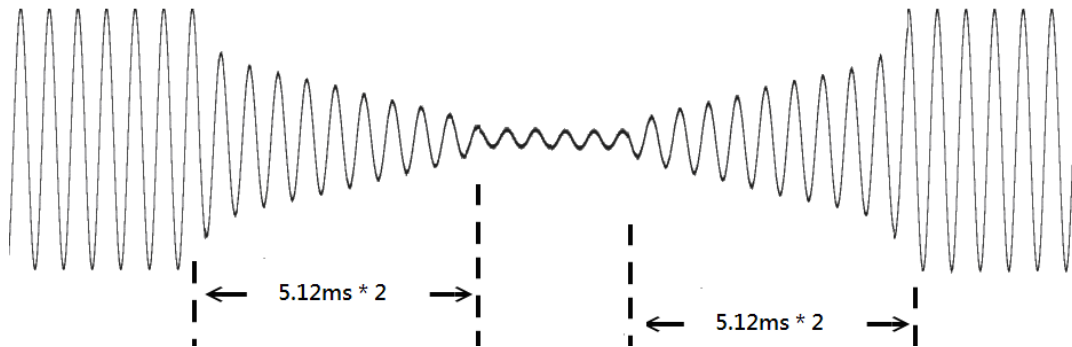


**+8dB → -16dB → +8dB**

$V_{in} = 0.5V_{rms}$  @ 1KHz



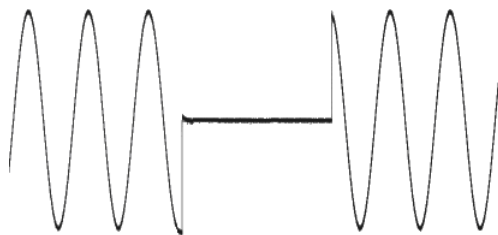
Soft-Step OFF



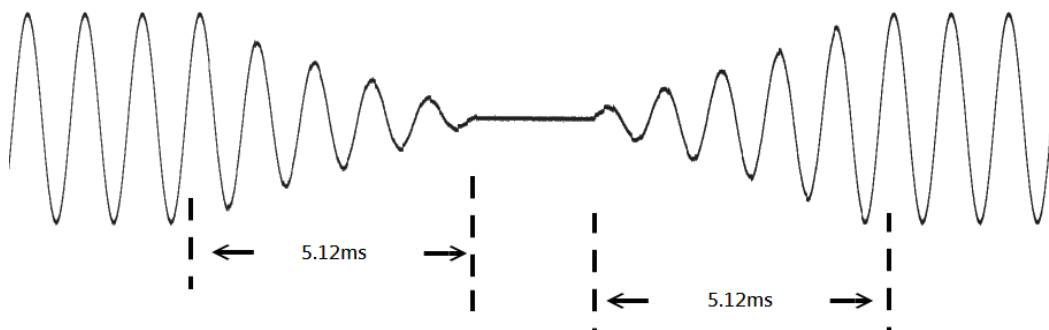
Soft-Step ON

**0dB → Mute → 0dB**

$V_{in} = 1V_{rms}$  @ 1KHz



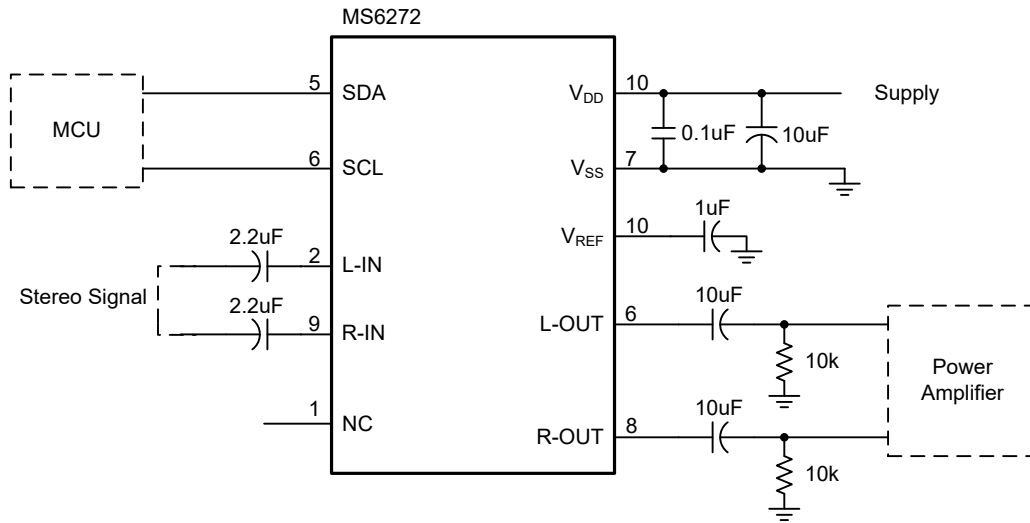
Soft-Step OFF



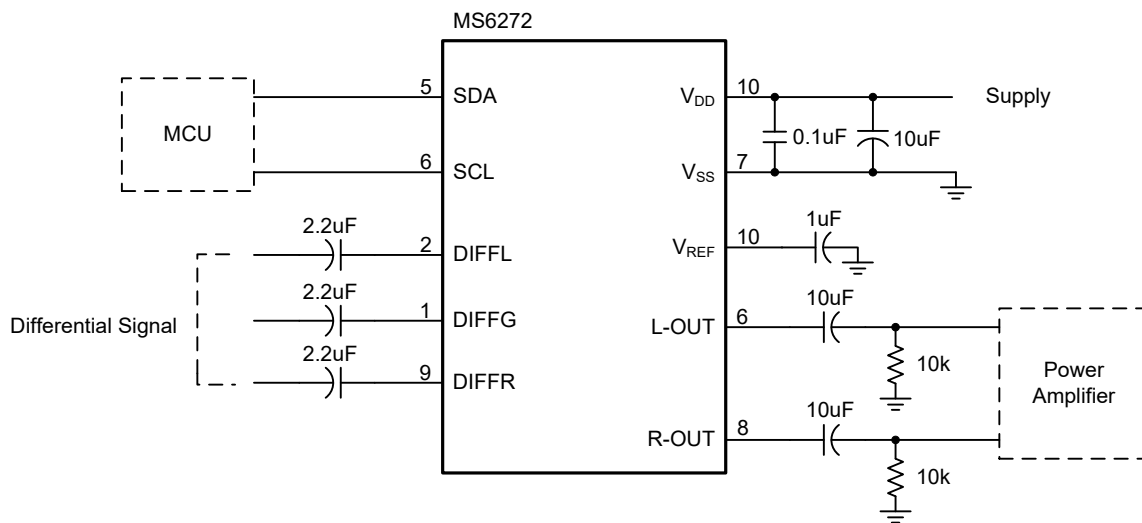
Soft-Step ON

## APPLICATION INFORMATION

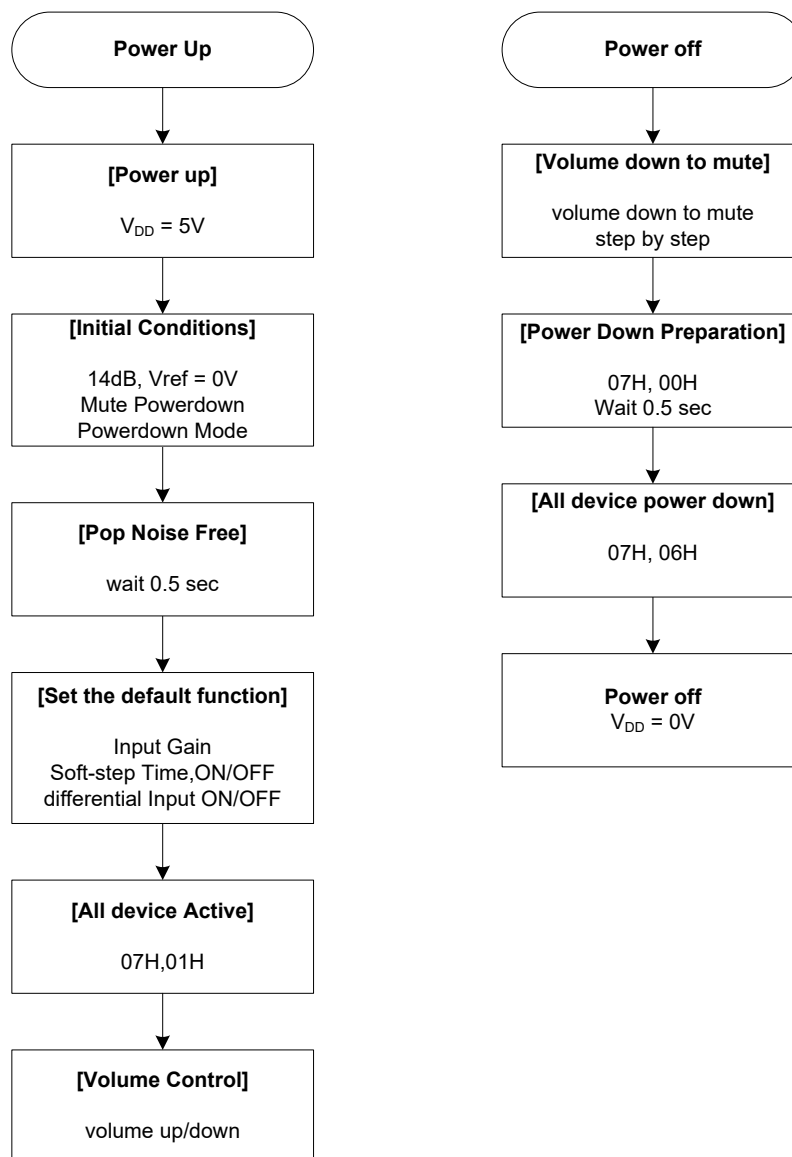
### Basic application example(Single-ended Mode)



### Basic application example(Differential Mode)

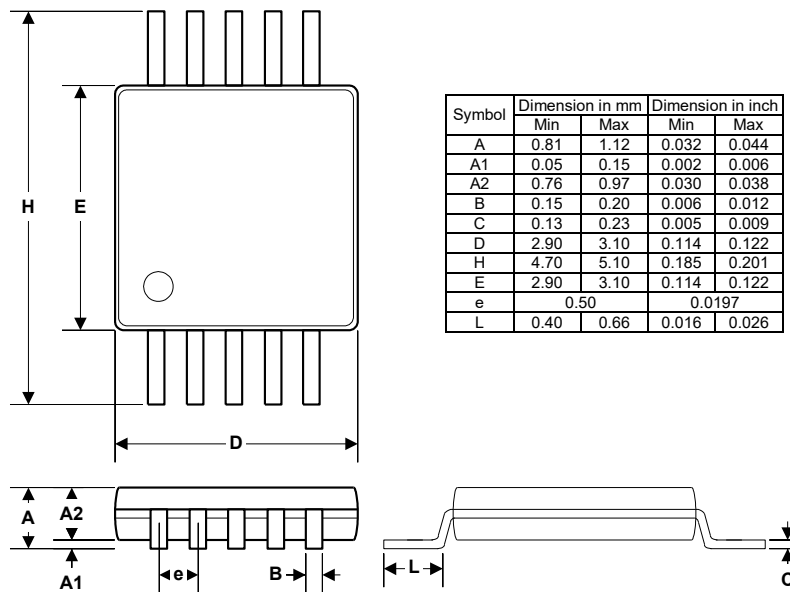


## Basic application flowchart

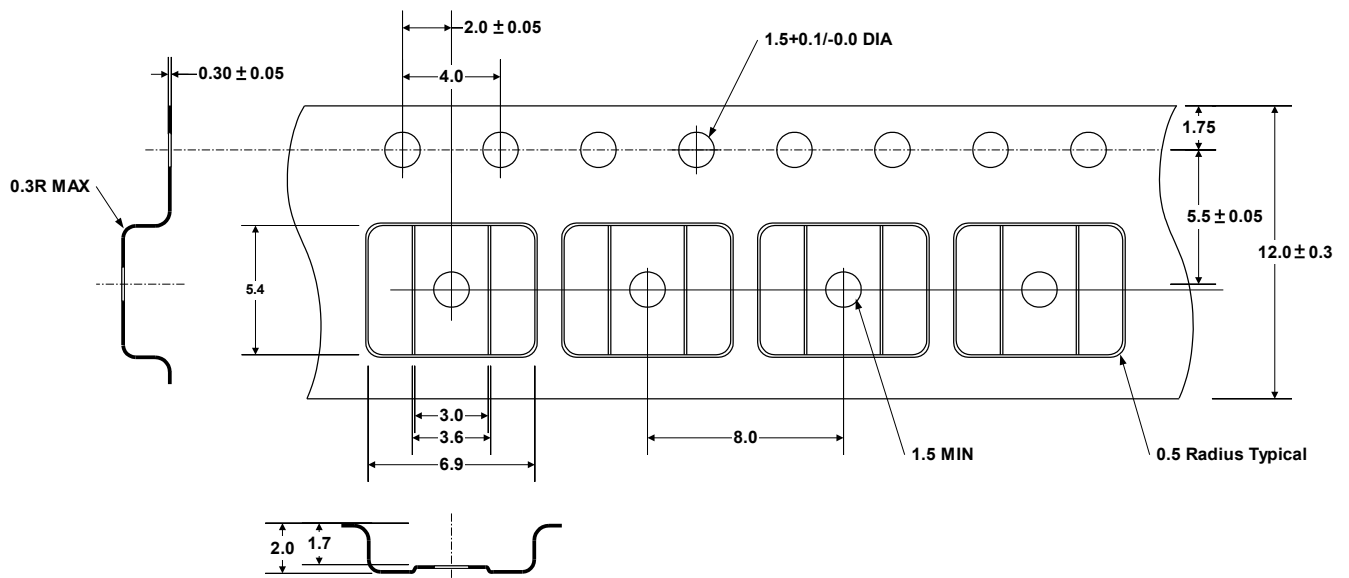


## EXTERNAL DIMENSIONS

### MSOP10 package

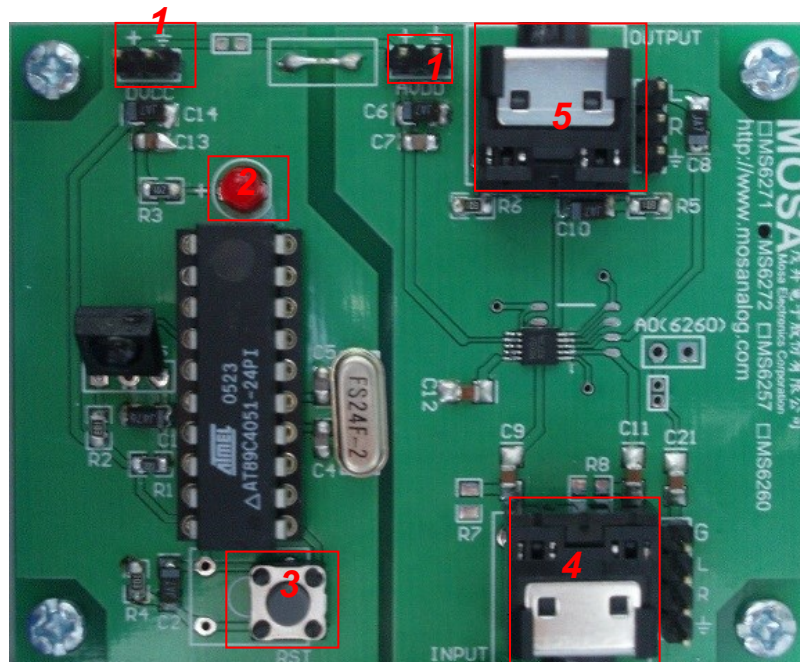


### TAPE AND REEL (Unit : mm)



## DEMO BOARD

The demo board used IR technique controller to control the MS6272. The default states of demo board are Input Gain 0dB, Volume 0dB, SE Mode, Softstep off, Mute off.



### Label 1: Supply Voltage

The AVDD and DVDD should be the same supply voltage, the supply range is 2.5 ~ 6.5 VDC.

### Label 2: LED Indicator

The LED indicates the power status and the IR received status. It is red-dark blink once when the MCU has received the function code correctly.

### Label 3: MCU Reset

The MS6272 will be loaded the default values by MCU. The default states of demo board : Input Gain 0dB, Volume 0dB, Softstep off , SE Mode , mute-off.

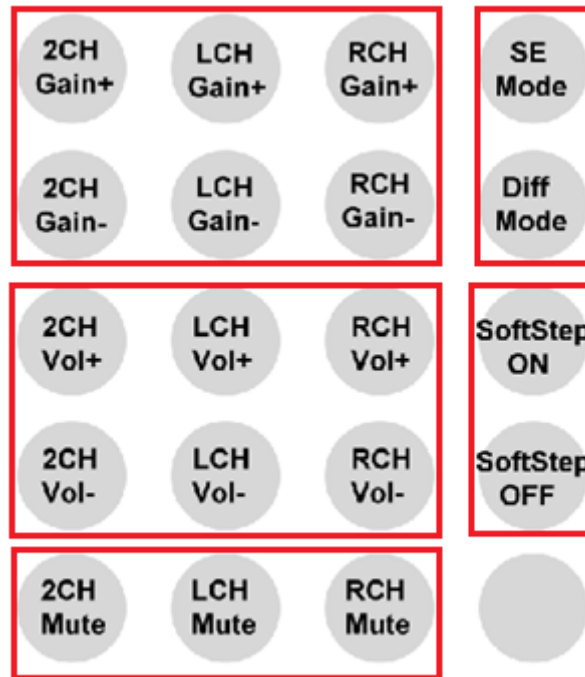
### Label 4: Input Section

Please input stereo audio signal, as music or sine wave.

### Label 5: Output Section

Please connected to a post-power-amplifier, as active speaker.

## IR Controller



**Gain+/- :** The gain control keys.

The gain control in 1dB/step as the switch is pressed once, the range is 0dB to 15dB.

**Vol+/- :** The volume control keys.

The volume control in 1dB/step as the switch is pressed once, the range is -79dB to +15dB.

**MUTE :** The mute key controls all speaker outputs  
Press the key once to set mute-on or mute-off.

**SE/Diff Mode :** The Input Mode control Keys.

**SoftStep :** The SoftStep key.  
Press the key once to set Softstep on or SoftStep off.

## Circuit

